

Appl. No. 10/667,134
Amdt. Dated February 12, 2007
Reply to Office Action of September 11, 2006

Attorney Docket No. 89227.0005
Customer No.: 26021

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Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1-2. (Canceled)

3. (Previously presented) The laminate as set forth in Claim 5, wherein:

the acid dianhydride component includes the pyromellitic dianhydride in a range of from 5 mole% to 90 mole%.

4. (Previously presented) The laminate as set forth in Claim 5, wherein:

the diamine component includes the paraphenylene diamine in a range of from 25 mole% to 75 mole%, and diaminodiphenyl ether in a range of from 25 mole% to 75 mole%.

5. (Currently amended) A laminate comprising a metal layer and a polyimide film, the metal layer being directly formed on the polyimide film having a dynamic viscoelasticity whose $\tan \delta$ peak is located in a range of not less than 310°C but not more than 410°C, and whose $\tan \delta$ value at 300°C is not more than 0.05, the polyimide film prepared by copolymerizing an acid dianhydride component and a diamine component,

the acid dianhydride component including a pyromellitic dianhydride represented by Equation (1):

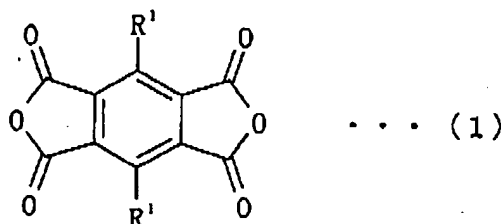
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where R^1 is a residue selected from a group consisting of $H-$, CH_3- , CF_3- , $Cl-$, $Br-$, $F-$, and CH_3O- , and R^1 may be the same residues or different residues, and the diamine component including a paraphenylene diamine and a diaminodiphenyl ether,

the paraphenylene diamine being represented by Equation (2):



where R^2 is a bivalent aromatic group selected from a group consisting of:

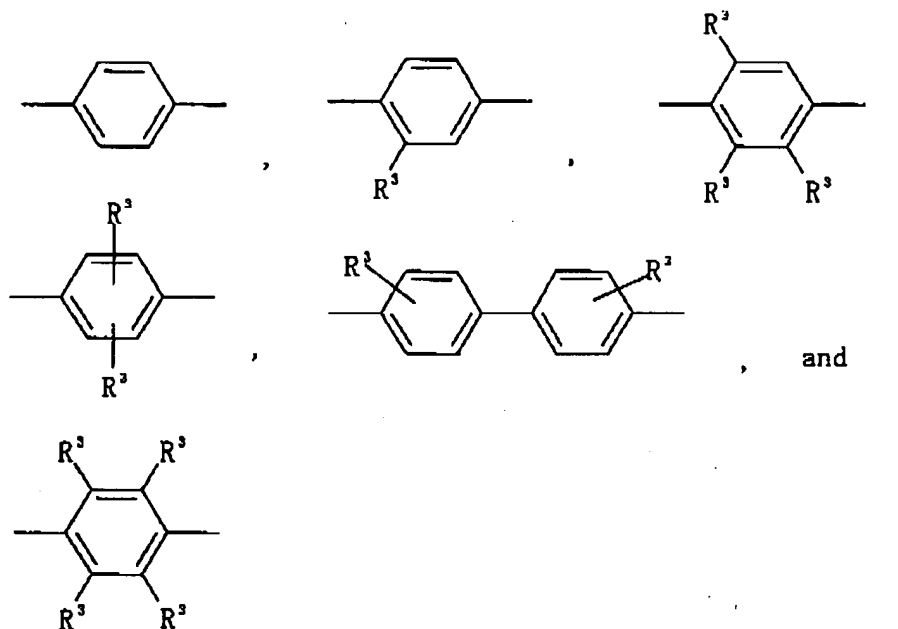
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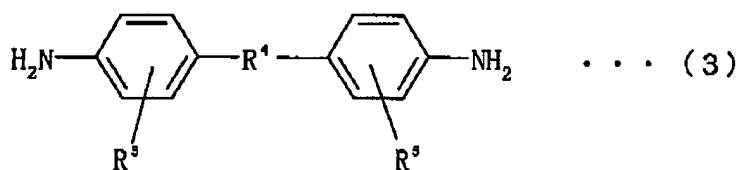
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and each R³ in the group is independently any one of -H, -CH₃, -OH, -CF₃, -SO₄, -COOH, -CO-NH₂, -Cl, -Br, -F, and -OCH₃, and the diaminodiphenyl ether being represented by General Formula (3):



where R⁴ is a bivalent organic group selected from a group consisting of:

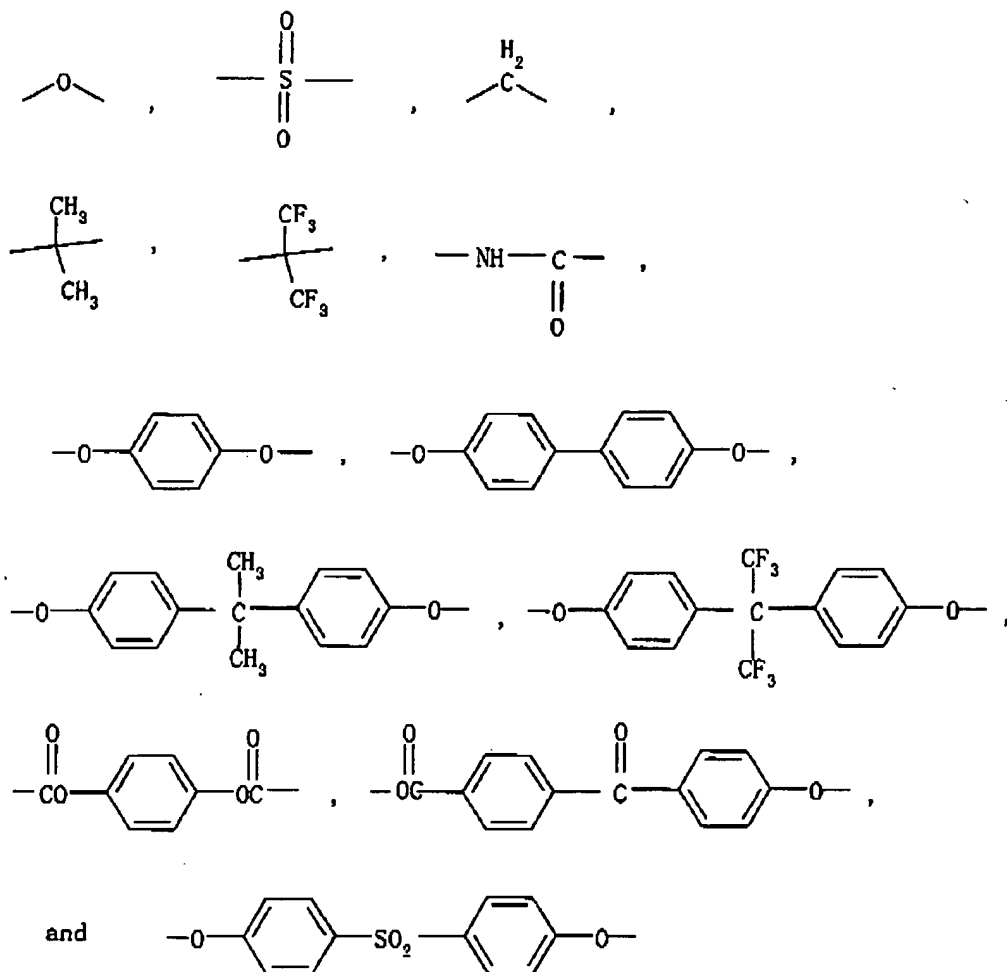
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and each R^5 in the group is independently any one of —H , —CH_3 , —OH , —CF_3 , —SO_4 , —COOH , —CO—NH_2 , —Cl , —Br , —F , and —OCH_3 ,
wherein:

the acid dianhydride component further includes a bis(trimellitic monoester anhydride) and/or a biphenyl tetracarboxylic dianhydride,

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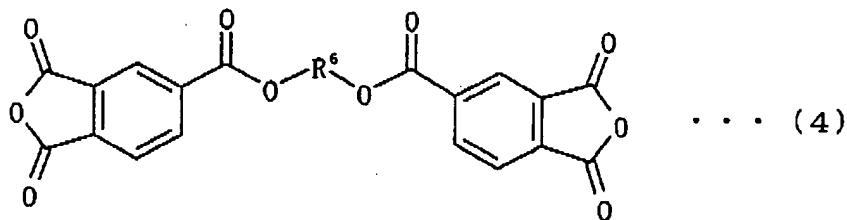
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~~the bis(trimellitic monoester anhydride)~~ being represented by
General Formula (4):



where R^6 is a bivalent organic group selected from a group consisting of:

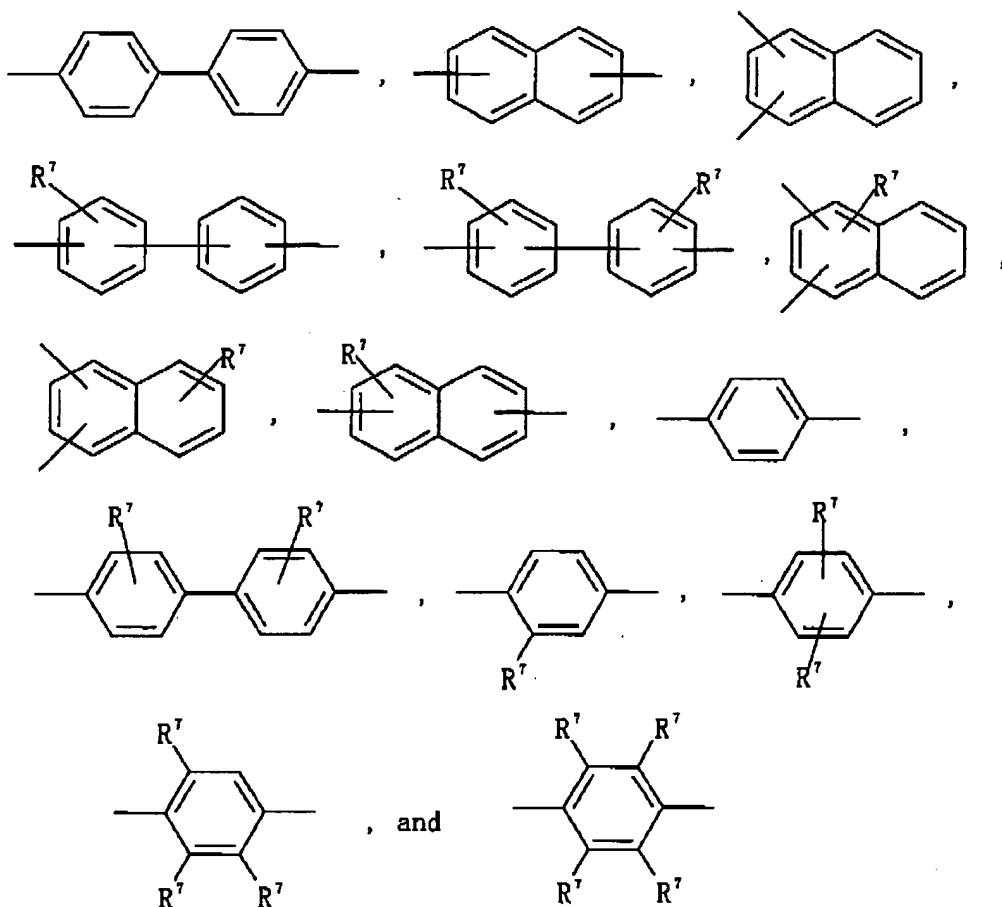
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and each R^7 is independently any one of -H, -CH₃, -OH, -CF₃, -SO₄, -COOH, and -CO-NH₂.

6. (Previously presented) The laminate as set forth in Claim 5, wherein

the acid dianhydride component includes the bis(trimellitic monoester anhydride) in a range of from 20 mole% to 40 mole%.

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7. (Currently amended) The laminate as set forth in Claim [[5]]
26, wherein

the acid dianhydride component includes the biphenyl
tetracarboxylic dianhydride in a range of from 0 mole% to 50 mole%.

8. (Previously presented) The laminate as set forth in Claim 5,
wherein:

the polyimide film has a coefficient of hygroscopic expansion is
16ppm/%RH or less, and a water absorption percentage is 2.0% or less.

9-10. (Canceled)

11. (Currently amended) A polyimide film prepared by
copolymerizing an acid dianhydride component and a diamine
component,

the acid dianhydride component including a pyromellitic
dianhydride represented by General Formula (1), a bis(trimellitic
monoester anhydride) represented by General Formula (4), and a biphenyl
tetracarboxylic dianhydride represented by General Formula (5), the
pyromellitic dianhydride being represented by General Formula (1):

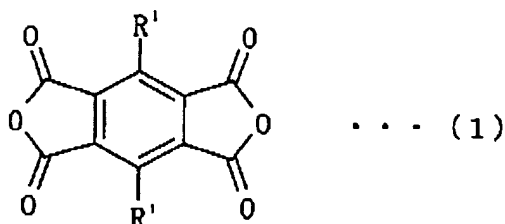
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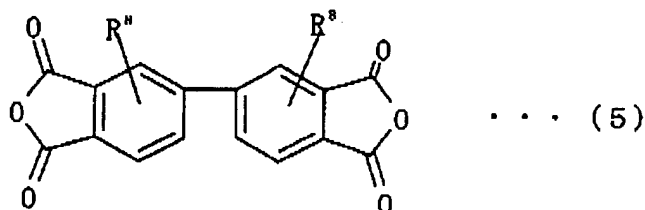
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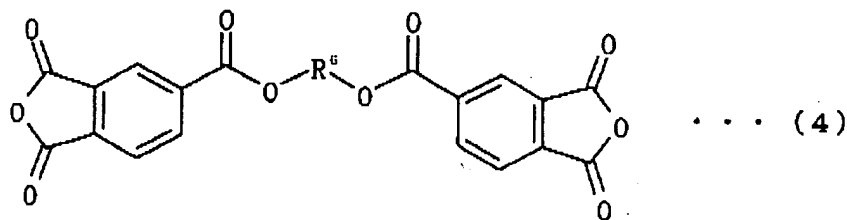
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where R^1 is a residue selected from a group consisting of H-, CH_3 -, CF_3 -, Cl-, Br-, F-, and CH_3O -, and R^1 may be the same residues or different residues, ~~and the biphenyl tetracarboxylic dianhydride being represented by General Formula (5):~~



where R^8 is a residue selected from a group consisting of H-, CH_3 -, Cl-, Br-, F- and CH_3O -, and R^8 may be the same residues or the different residues, and



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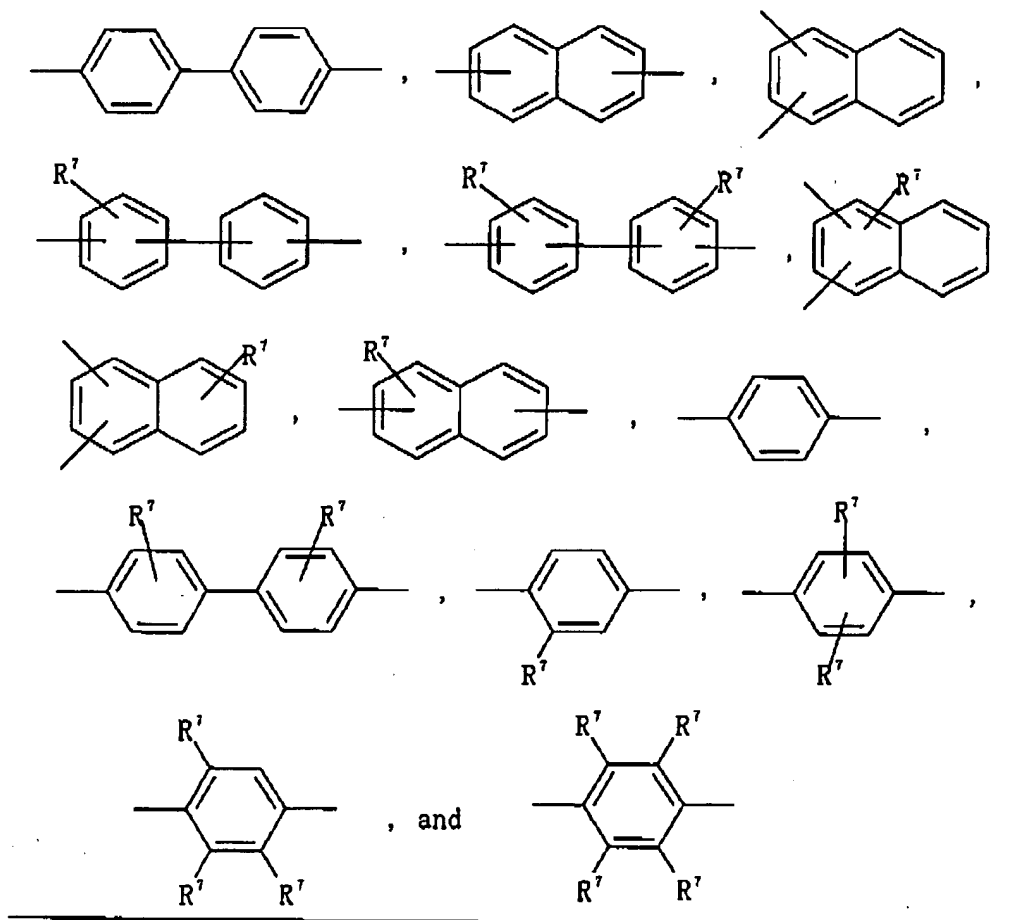
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where R^6 is a bivalent organic group selected from a group consisting of:



and each R^7 is independently any one of -H, -CH₃, -OH, -CF₃, -SO₄, -COOH, and -CO-NH₂.

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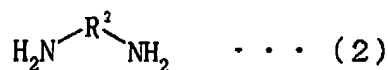
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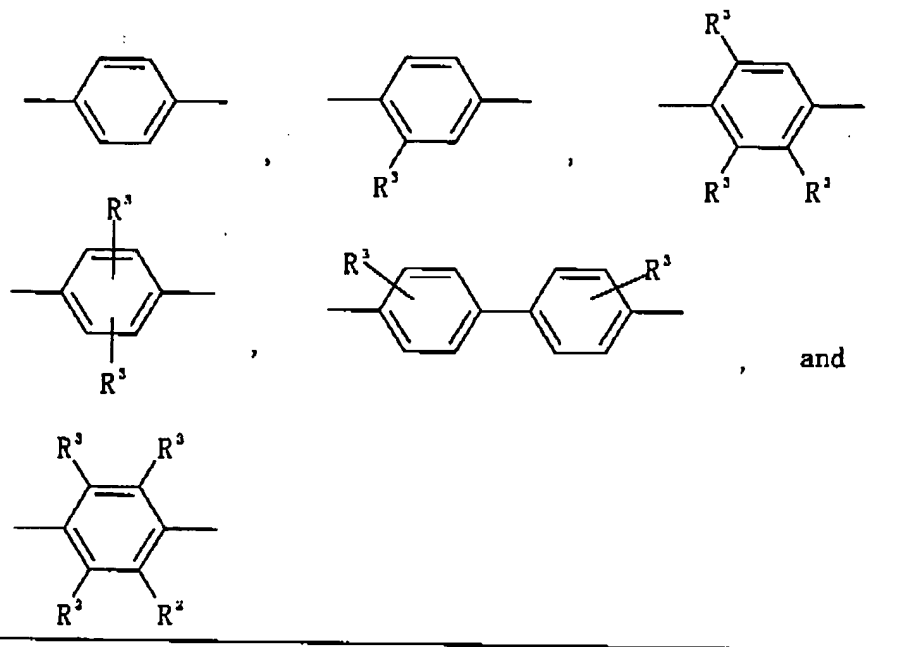
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the diamine component including a paraphenylene diamine represented by General Formula (2) and a diaminodiphenyl ether represented by General Formula (3), and



where R^2 is a bivalent aromatic group selected from a group consisting of:



and each R^3 in the group is independently any one of -H, -CH₃, -OH, -CF₃, -SO₄, -COOH, -CO-NH₂, -Cl, -Br, -F, and -OCH₃, and the diaminodiphenyl ether being represented by General Formula (3):

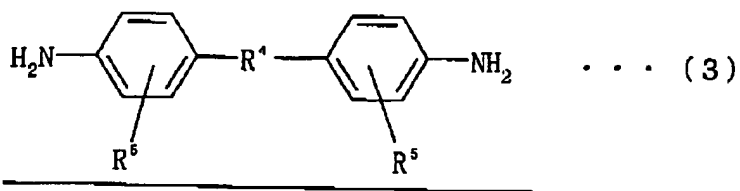
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where R^4 is a bivalent organic group selected from a group consisting of:

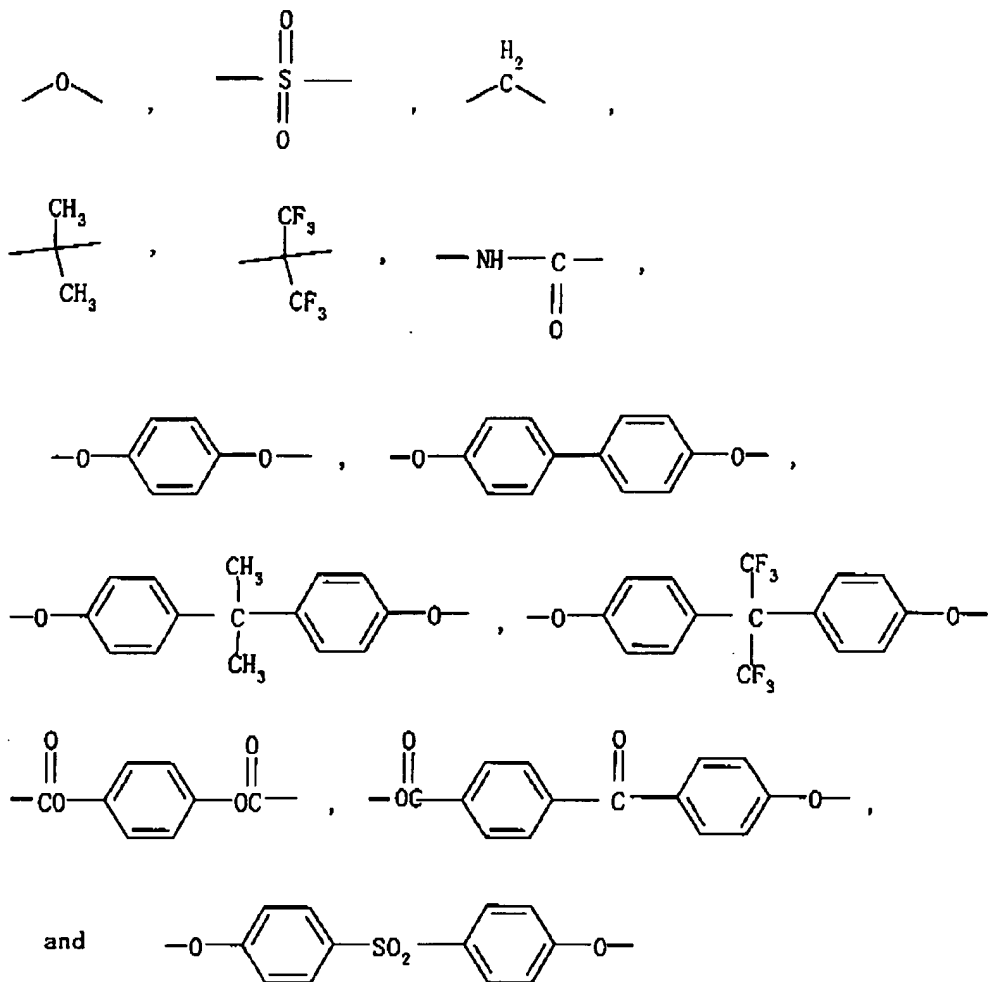
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and each R⁵ in the group is independently any one of -H, -CH₃, -OH, -CF₃, -SO₄, -COOH, -CO-NH₂, -Cl, -Br, -F, and -OCH₃.

the polyimide film having such an etching speed that one side thereof is etched with a 1N potassium hydroxide solution at an etching speed of 0.1µm/minute (one side) or higher.

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12. (Canceled)

13. (Original) The polyimide film as set forth in Claim 11, wherein:

the acid dianhydride component includes the pyromellitic dianhydride in a range of from 30 mole% to 99.9 mole%, and the biphenyl tetracarboxylic dianhydride in a range of from 0.1 mole% to 50 mole%.

14. (Currently amended) The polyimide film as set forth in Claim ~~[[12]]~~ 11, wherein:

the diamine component includes the paraphenylene diamine in a range of from 15 mole% to 85 mole%, and diaminodiphenyl ether in a range of from 15 mole% to 85 mole%.

15. (Canceled)

16. (Currently amended) The polyimide film as set forth in Claim ~~[[15]]~~ 11, wherein:

The acid dianhydride component includes the bis(trimellitic monoester anhydride) in a range of from 10 mole% to 50 mole%.

17. (Original) The polyimide film as set forth in Claim 11, wherein:

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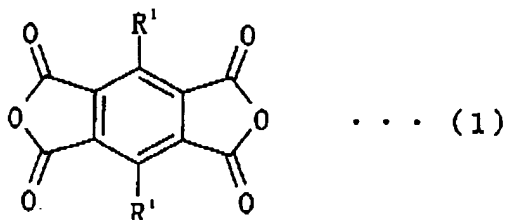
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a retention percent of tear-through resistance of the polyimide film after exposing the polyimide film to environment of a temperature of 150°C, a humidity of 100%RH, and 4 atmospheric pressure for 48 hours is not less than 50%.

18. (Currently amended) A laminate comprising: a metal layer; and a polyimide that is manufactured with

a polyimide film that is prepared by copolymerizing an acid dianhydride component and a diamine component,

the acid dianhydride component including a pyromellitic dianhydride and a biphenyl tetracarboxylic dianhydride, the pyromellitic dianhydride being represented by General Formula (1):



where R¹ is a residue selected from a group consisting of H-, CH₃-, CF₃, Cl-, Br-, F-, and CH₃O-, and R¹ may be the same residues or different residues, and

a biphenyl tetracarboxylic dianhydride being represented by General Formula (5):

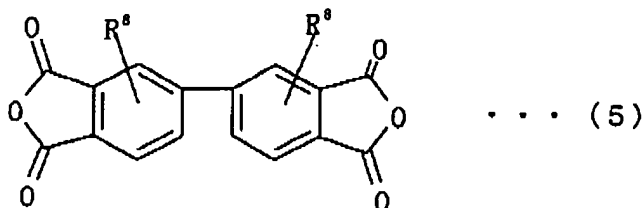
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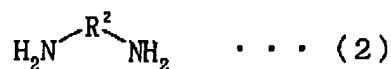
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where R^8 is a residue selected from a group consisting of H-, CH_3 -, Cl-, Br-, F- and CH_3O -, and R^8 may be the same residues or the different residues,

the diamine component including a paraphenylene diamine represented by General Formula (2)



where R^2 is a bivalent aromatic group selected from a group consisting of:

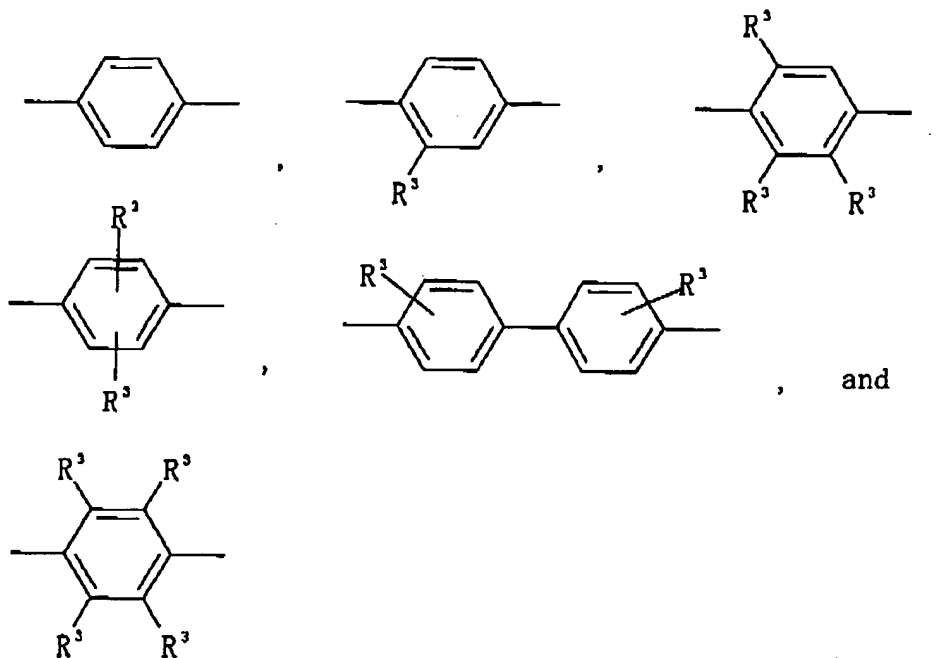
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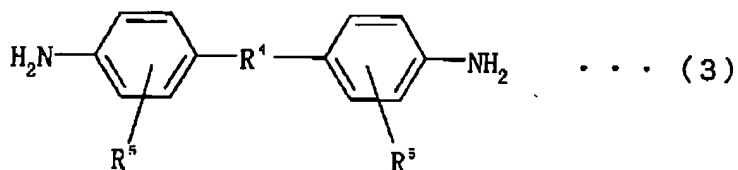
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and each R³ in the group is independently any one of -H, -CH₃, -OH, -CF₃, -SO₄, -COOH, -CO-NH₂, -Cl, -Br, -F, and -OCH₃, and a diaminodiphenyl ether represented by General Formula (3),



where R⁴ is a bivalent organic group selected from a group consisting of:

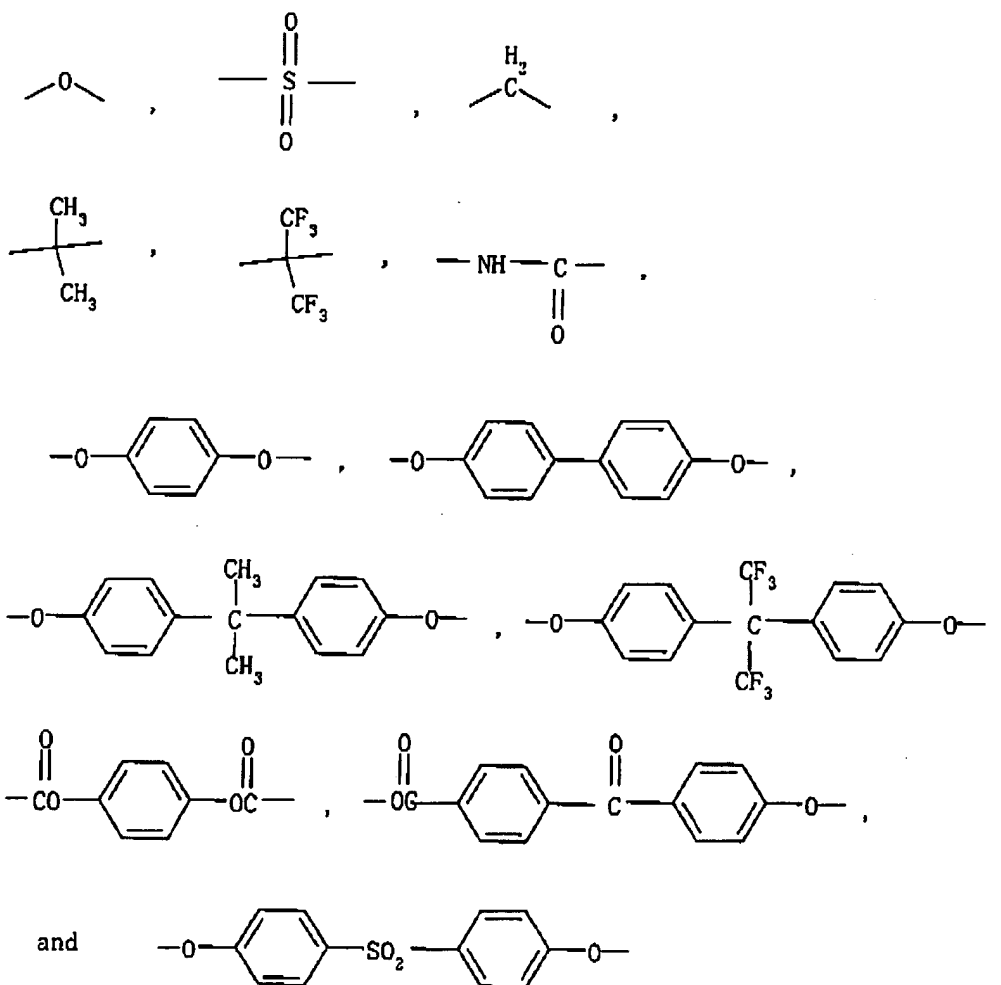
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and each R^5 in the group is independently any one of —H , —CH_3 , —OH , —CF_3 , —SO_4 , —COOH , —CO—NH_2 , —Cl , —Br , —F , and —OCH_3 ,
wherein:

the acid dianhydride component further including a bis(trimellitic monoester anhydride) represented by General Formula (4),

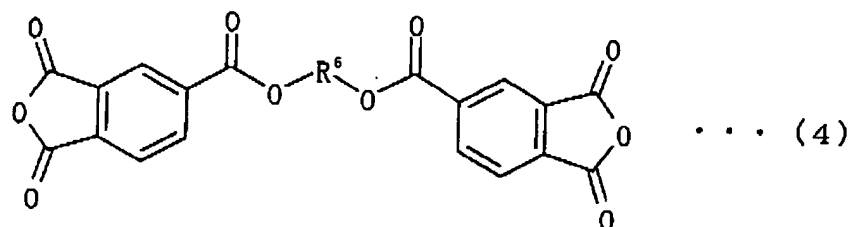
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where R^6 is a bivalent organic group selected from a group consisting of:

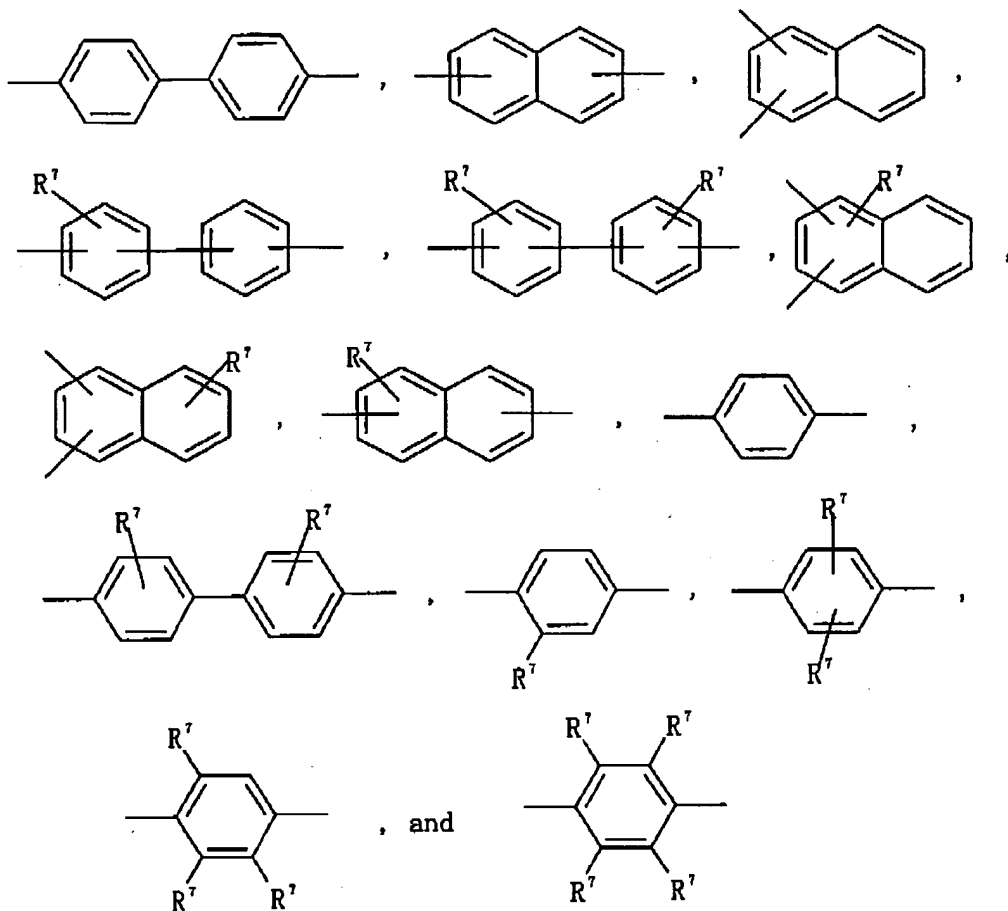
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and each R^7 is independently any one of $-\text{H}$, $-\text{CH}_3$, $-\text{OH}$, $-\text{CF}_3$, $-\text{SO}_4$, $-\text{COOH}$, and $-\text{CO-NH}_2$,

the polyimide film having such an etching speed that one side thereof is etched with a 1N potassium hydroxide solution at an etching speed of 0.1 $\mu\text{m}/\text{minute}$ (one side) or higher.

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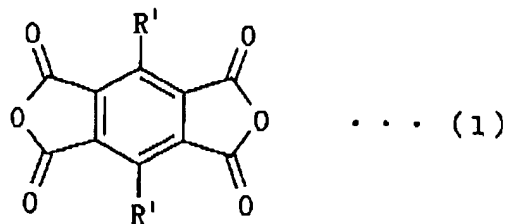
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19. (Currently amended) A polyimide film prepared by copolymerizing an acid dianhydride component and a diamine component,

the acid dianhydride component including the pyromellitic dianhydride, represented by General Formula (1), in a range of from ~~[[40]]~~ 50 mole% to ~~[[80]]~~ 70 mole%, the biphenyl tetracarboxylic dianhydride, represented by General Formula (5) in a range of from 1 mole% to 40 mole%, and the bis(trimellitic monoester anhydride, represented by General Formula (4), in a range of from 20 mole% to 50 mole%, and

the diamine component including the paraphenylene diamine, represented by General Formula (2), in a range of 25 mole% to 75 mole%, and the diaminodiphenyl ether, represented by General Formula (3), in a range of 25 mole% to 75 mole%, where General Formula (1) is:



where R¹ is a residue selected from a group consisting of H-, CH₃-, CF₃-, Cl-, Br-, F-, and CH₃O-, and R¹ may be the same residues or different residues;

General Formula (5) is:

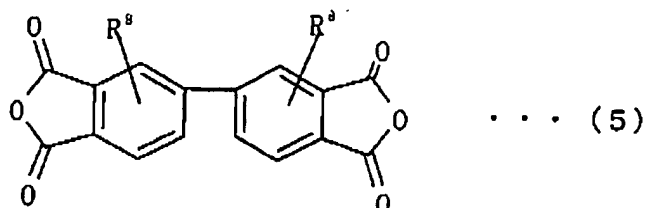
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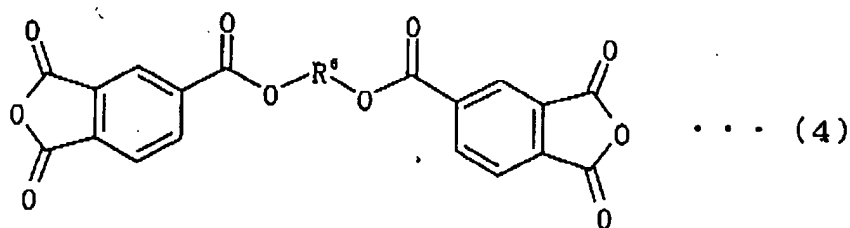
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where R^a is a residue selected from a group consisting of H-, CH_3 -, Cl-, Br-, F- and CH_3O -, and R^a may be the same residues or the different residues;

General Formula (4) is:



where R^b is a bivalent organic group selected from a group consisting of:

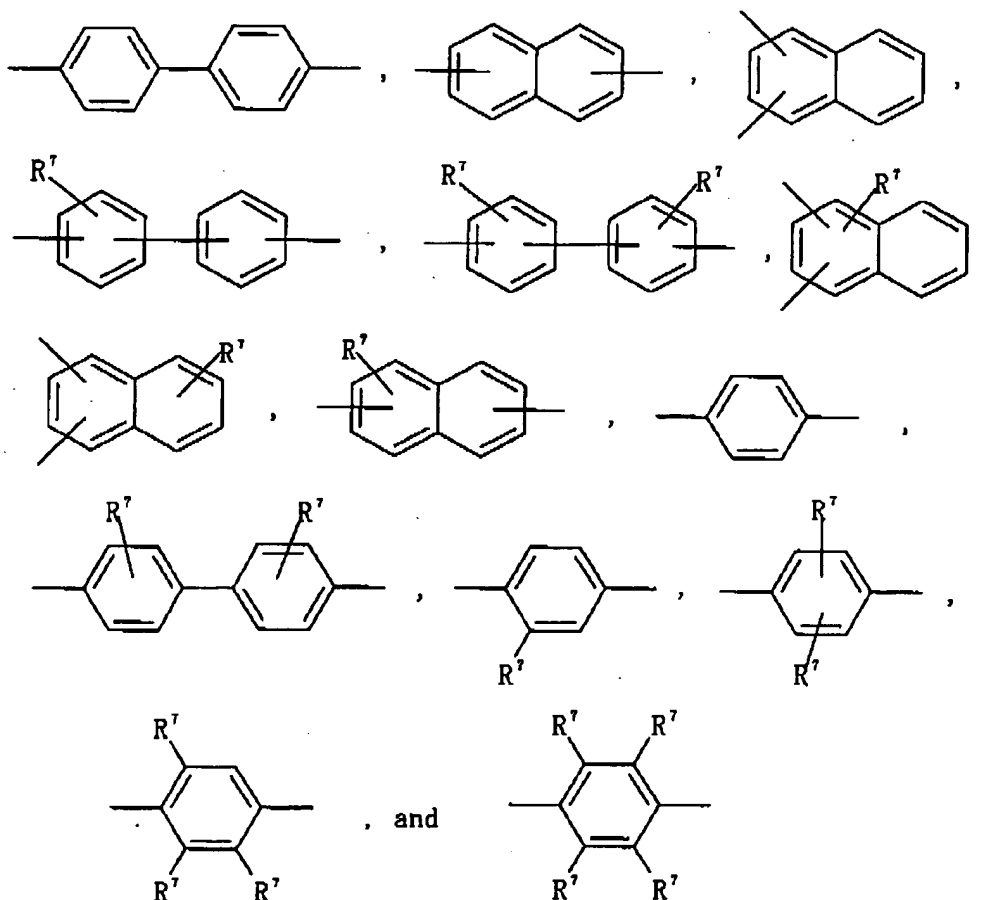
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and each R^7 is independently any one of $-H$, $-CH_3$, $-OH$, $-CF_3$, $-SO_4$, $-COOH$, and $-CO-NH_2$;

General Formula (2) is:



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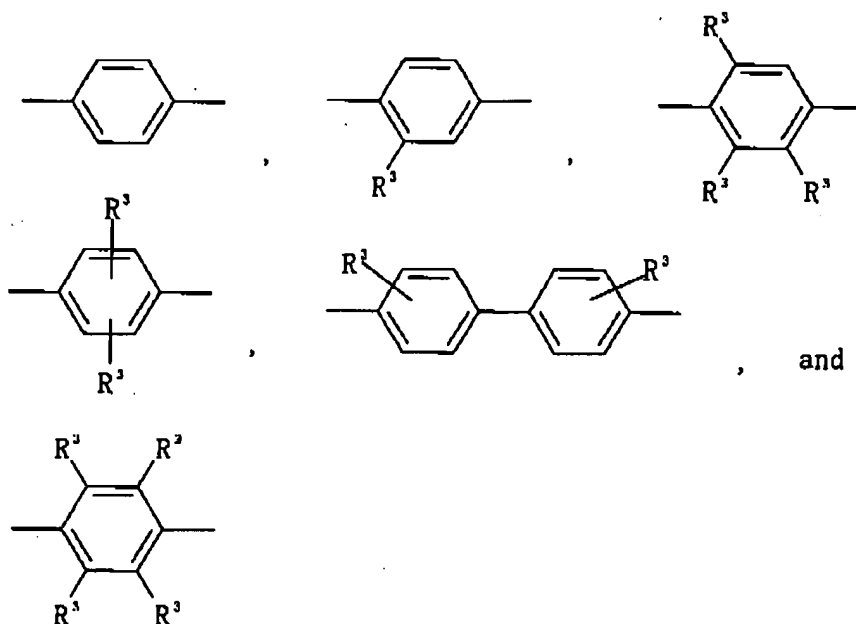
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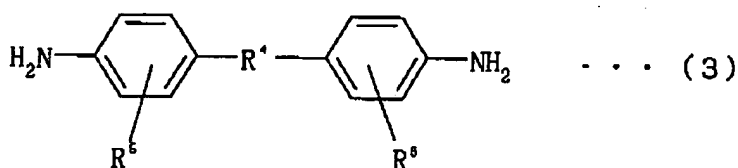
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where R^2 is a bivalent aromatic group selected from a group consisting of:



and each R^3 in the group is independently any one of -H, -CH₃, -OH, -CF₃, -SO₄, -COOH, -CO-NH₂, -Cl, -Br, -F, and -OCH₃; and

General Formula (3) is:



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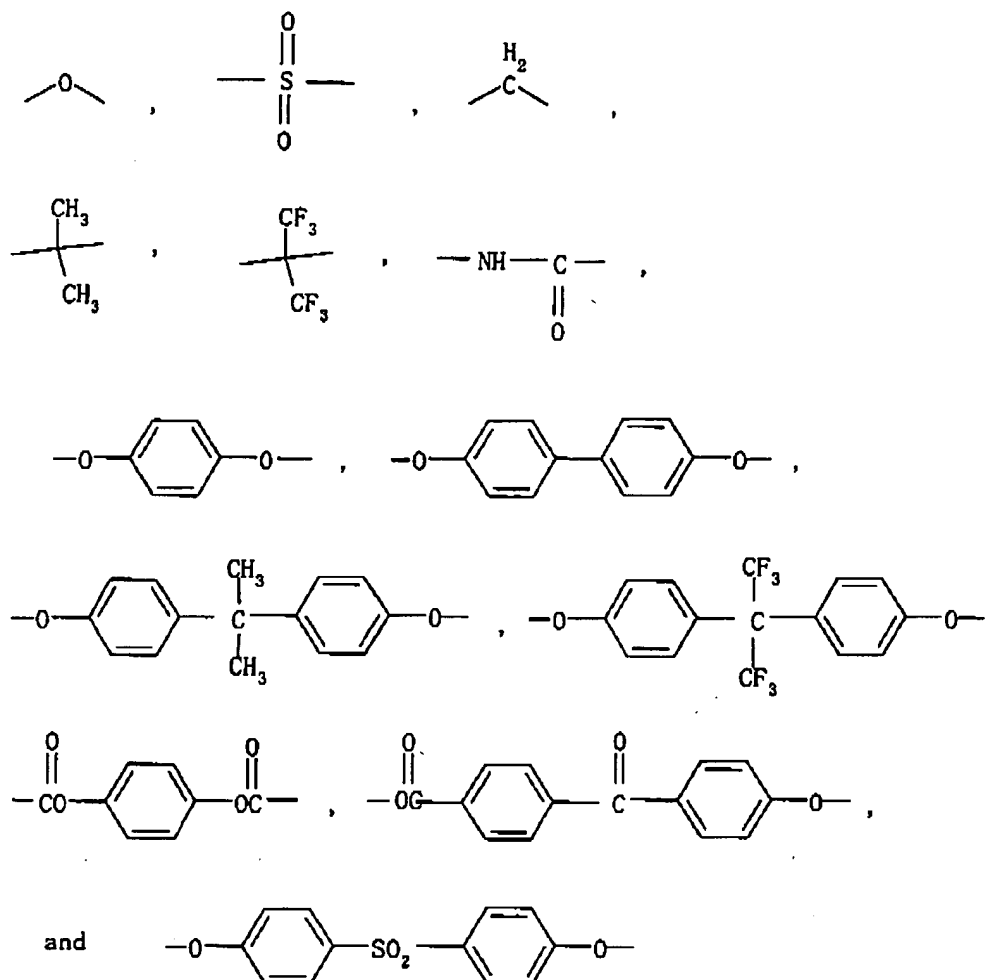
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where R^4 is a bivalent organic group selected from a group consisting of:



and each R^5 in the group is independently any one of $-\text{H}$, $-\text{CH}_3$, $-\text{OH}$, $-\text{CF}_3$, $-\text{SO}_4$, $-\text{COOH}$, $-\text{CO}-\text{NH}_2$, $-\text{Cl}$, $-\text{Br}$, $-\text{F}$, and $-\text{OCH}_3$.

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20. (Original) The polyimide film as set forth in Claim 19, the polyimide film having a thickness in a range of from 1 μ m to 200 μ m.

21. (Original) The polyimide film as set forth in Claim 19, the polyimide film having a modulus of elasticity in a range of from 500kg/mm² to 800kg/mm².

22. (Original) The polyimide film as set forth in Claim 19, the polyimide film having a coefficient of hygroscopic expansion in a range of from 2ppm/%RH to 20ppm/%RH.

23. (Original) The polyimide film as set forth in Claim 19, the polyimide film having a coefficient of liner expansion in a range of 1 to 30 $\times 10^{-6}$ cm/cm/ $^{\circ}$ C at a temperature of from 100 $^{\circ}$ C to 200 $^{\circ}$ C.

24. (Original) The polyimide film as set forth in Claim 19, wherein:

a peel strength at an interface between the polyimide film and a metal layer of laminate is not less than 5N/cm, the laminate having the polyimide film and the metal layer that is formed on the polyimide film by vacuum depositing and electroplating; and

a retention rate of the peel strength is not less than 10% after exposing the laminate to environment of a temperature of 121 $^{\circ}$ C and a humidity of 100%RH for 12 hours.

25. (Previously presented) Laminate comprising:

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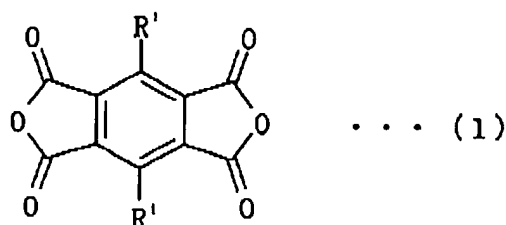
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a metal layer; and

a polyimide film prepared by copolymerizing an acid dianhydride component and a diamine component,

the acid dianhydride component including the pyromellitic dianhydride, represented by General Formula (1), in a range of from 40 mole% to 80 mole%, the biphenyl tetracarboxylic dianhydride, represented by General Formula (5) in a range of from 1 mole% to 40 mole%, and the bis(trimellitic monoester anhydride), represented by General Formula (4), in a range of from 20 mole% to 50 mole%, and

the diamine component including the paraphenylene diamine, represented by General Formula (2), in a range of 25 mole% to 75 mole%, and the diaminediphenyl ether, represented by General Formula (3), in a range of 25 mole% to 75 mole%, where General Formula (1) is:



where R¹ is a residue selected from a group consisting of H-, CH₃-, CF₃, Cl-, Br-, F-, and CH₃O-, and R¹ may be the same residues or different residues;

General Formula (5) is:

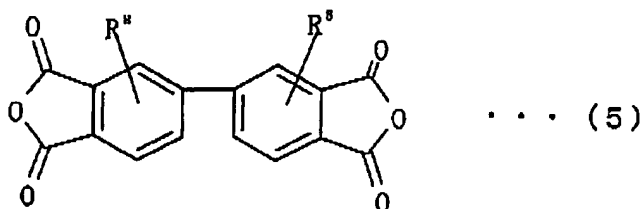
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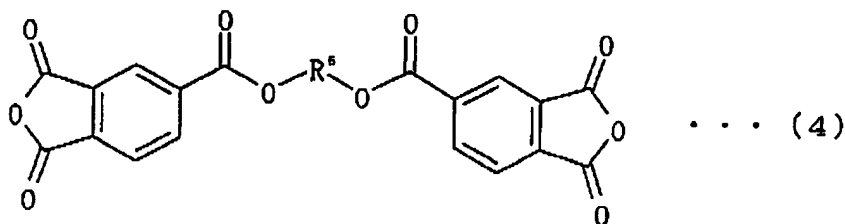
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where R^8 is a residue selected from a group consisting of H-, CH_3 -, Cl-, Br-, F- and CH_3O -, and R^8 may be the same residues or the different residues;

General Formula (4) is:



where R^6 is a bivalent organic group selected from a group consisting of:

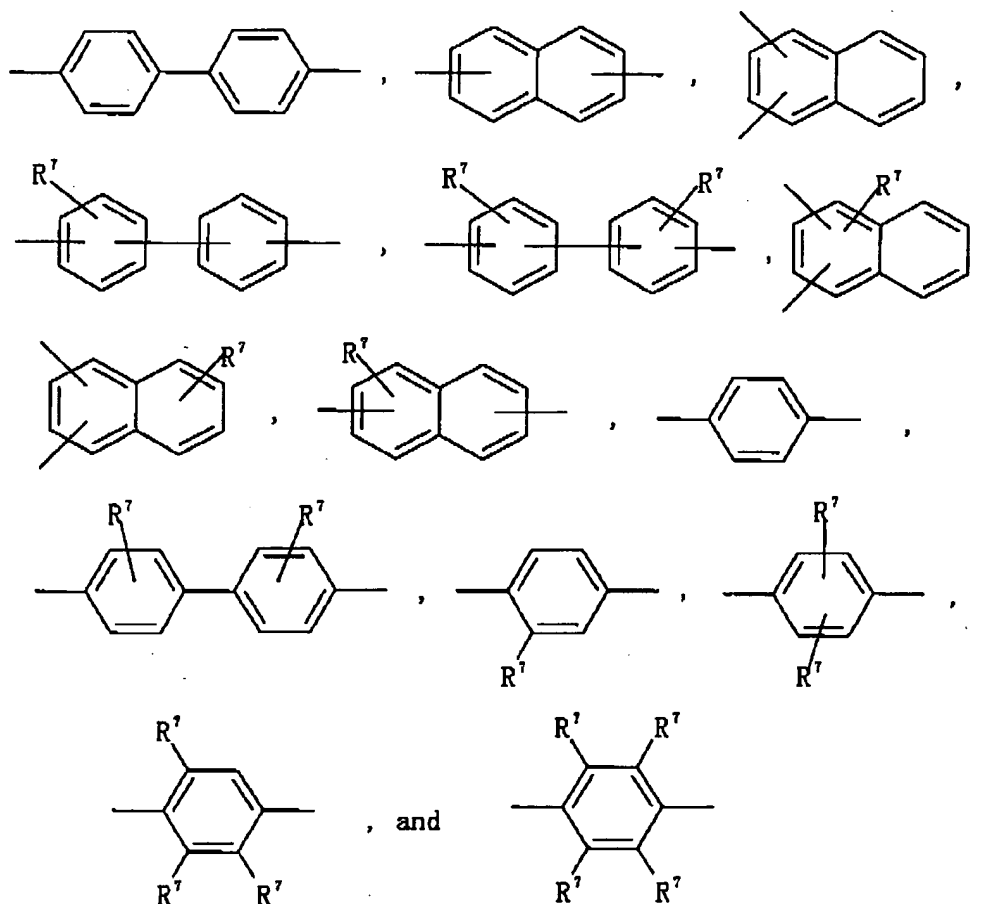
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and each R⁷ is independently any one of -H, -CH₃, -OH, -CF₃, -SO₄, -COOH, and -CO-NH₂;

General Formula (2) is:



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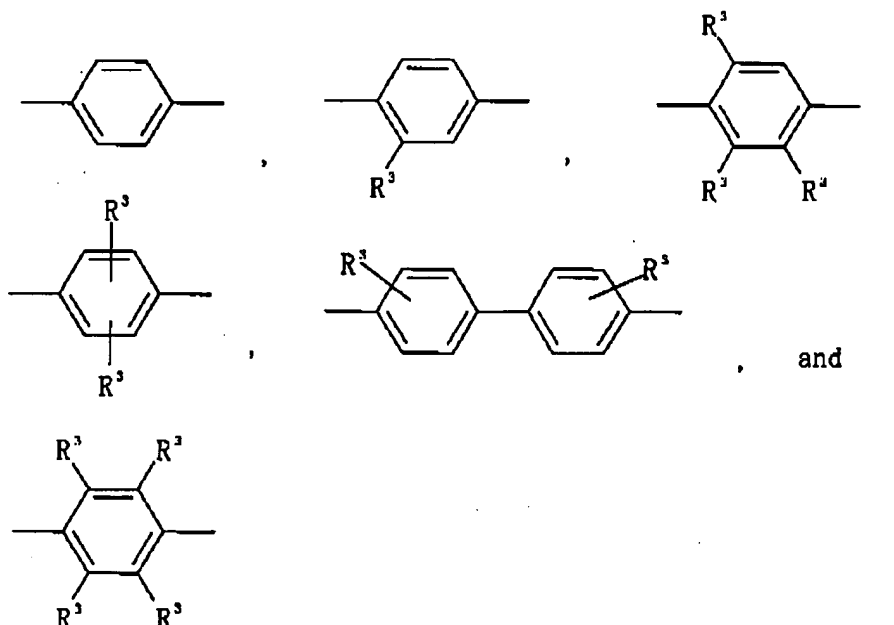
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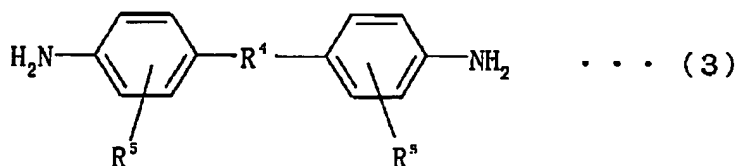
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where R^2 is a bivalent aromatic group selected from a group consisting of:



and each R^3 in the group is independently any one of -H, -CH₃, -OH, -CF₃, -SO₄, -COOH, -CO-NH₂, -Cl, -Br, -F, and -OCH₃; and

General Formula (3) is:



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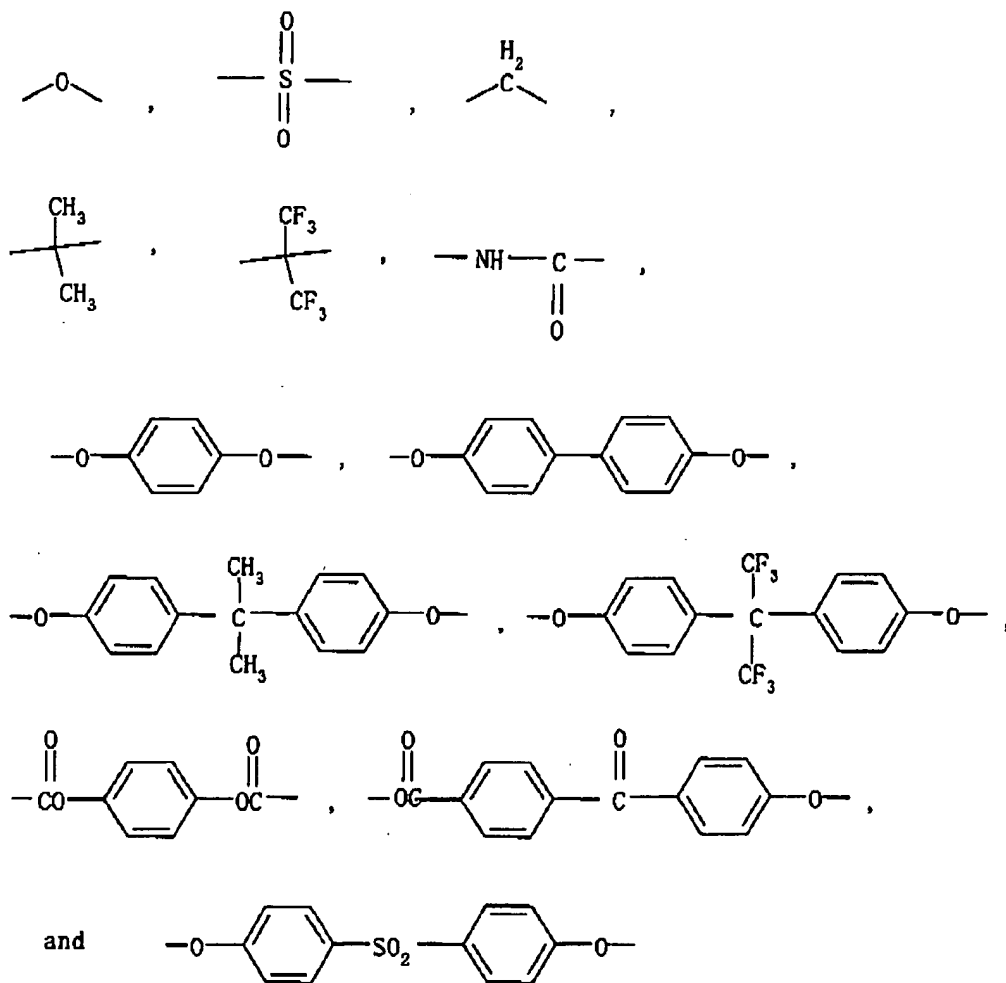
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where R^4 is a bivalent organic group selected from a group consisting of:



and each R^5 in the group is independently any one of -H, -CH₃, -OH, -CF₃, -SO₄, -COOH, -CO-NH₂, -Cl, -Br, -F, and -OCH₃.

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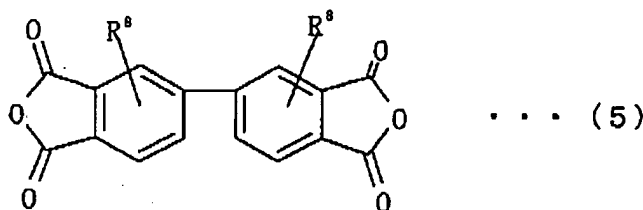
Attorney Docket No. 89227.0005

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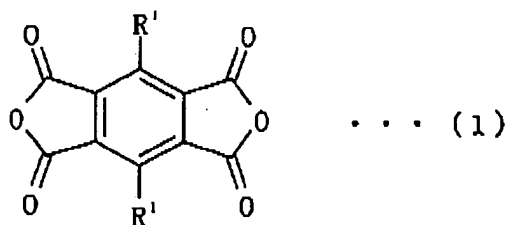
26. (Previously presented) The laminate as set forth in claim 5, wherein the acid dianhydride component includes a biphenyl tetracarboxylic dianhydride represented by General Formula (5)



where R^8 is a residue selected from a group consisting of H-, CH_3 -, Cl-, Br-, F- and CH_3O -, and R^8 may be the same residues or the different residues.

27. (Previously presented) A polyimide film prepared by copolymerizing an acid dianhydride component and a diamine component,

the acid dianhydride component including a pyromellitic dianhydride represented by General Formula (1),



where R^1 is a residue selected from a group consisting of H-, CH_3 -, CF_3 -, Cl-, Br-, F-, and CH_3O -, and R^1 may be the same residues or different residues, and

the diamine component including a paraphenylene diamine represented by General Formula (2)

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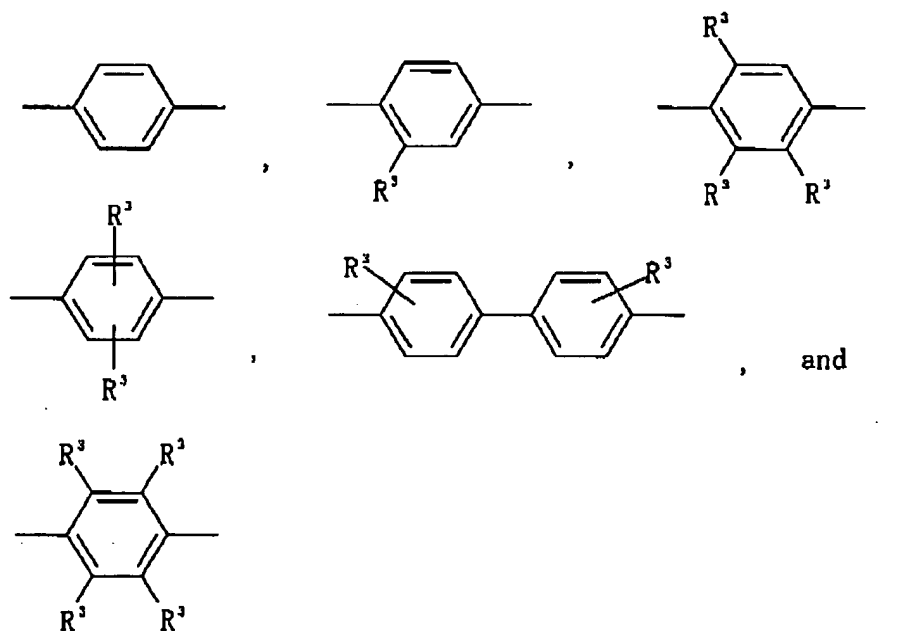
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where R^2 is a bivalent aromatic group selected from a group consisting of:



and each R^3 in the group is independently any one of -H, - CH_3 , -OH, - CF_3 , - SO_4 , - COOH , - CO-NH_2 , -Cl, -Br, -F, and - OCH_3 , and a diaminodiphenyl ether represented by General Formula (3),

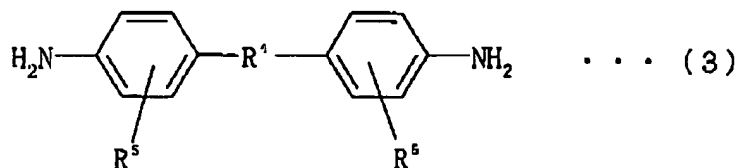
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where R^4 is a bivalent organic group selected from a group consisting of:

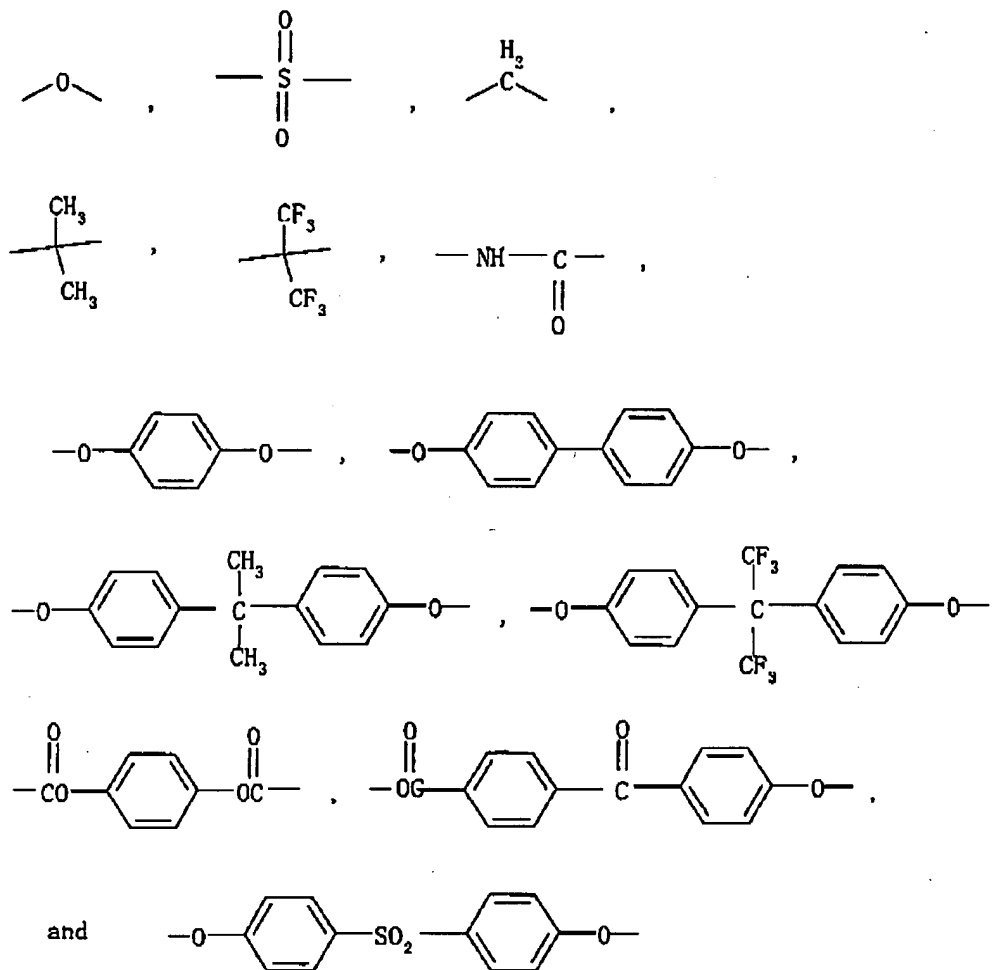
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and each R⁵ in the group is independently any one of -H, -CH₃, -OH, -CF₃, -SO₄, -COOH, -CO-NH₂, -Cl, -Br, -F, and -OCH₃,

wherein:

the acid dianhydride component further including a bis(trimellitic monoester anhydride) represented by General Formula (4),

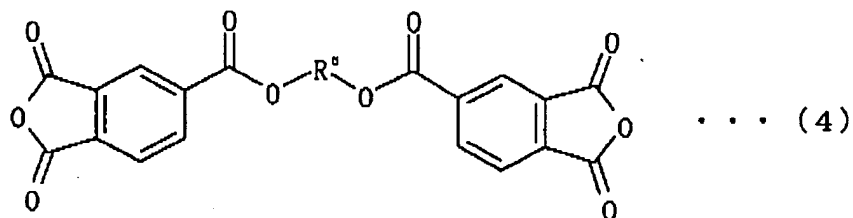
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where R^a is a bivalent organic group selected from a group consisting of:

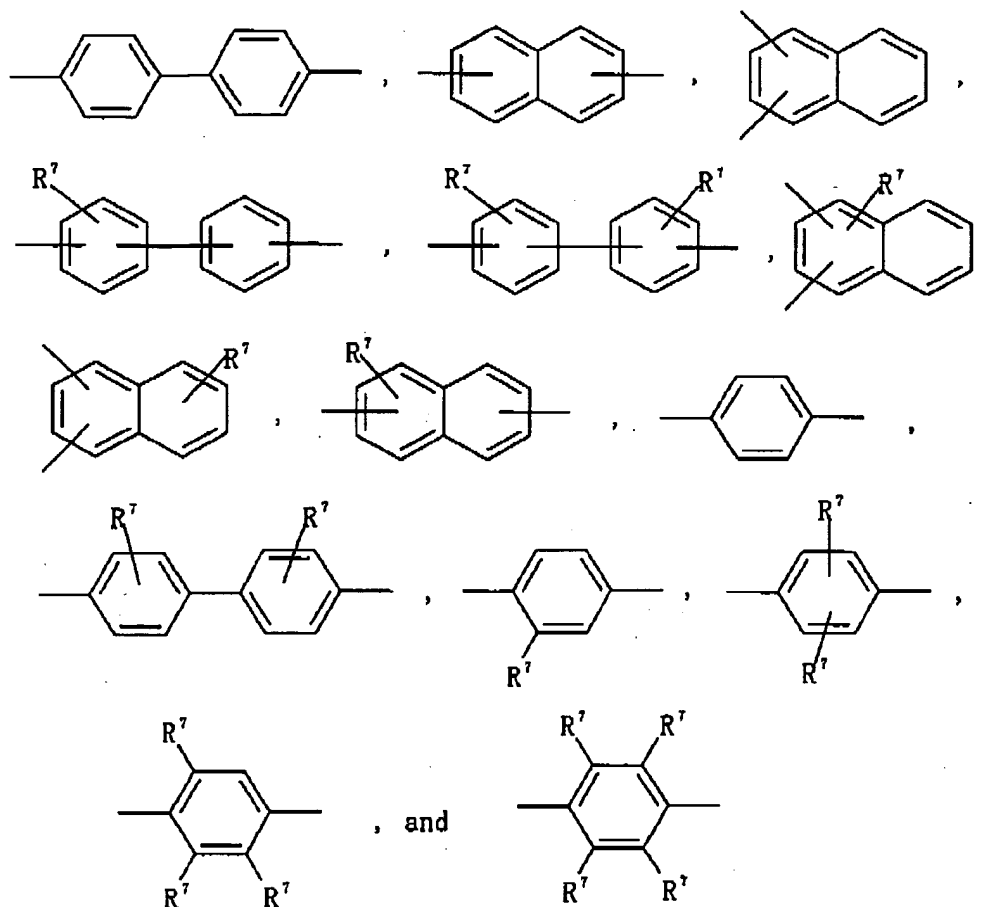
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and each R^7 is independently any one of -H, -CH₃, -OH, -CF₃, -SO₄, -COOH, and -CO-NH₂,

the polyimide film having a dynamic viscoelasticity whose tan δ peak is located in a range of not less than 310°C but not more than 410°C, and whose tan δ value at 300°C is not more than 0.05.

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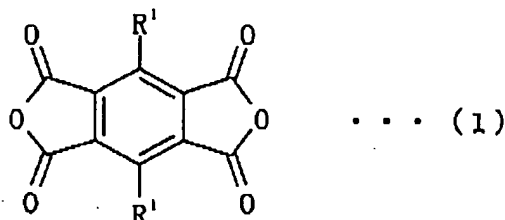
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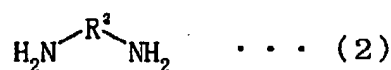
28. (Previously presented) A polyimide film prepared by copolymerizing an acid dianhydride component and a diamine component,

the acid dianhydride component including a pyromellitic dianhydride represented by General Formula (1),



where R¹ is a residue selected from a group consisting of H-, CH₃-, CF₃-, Cl-, Br-, F-, and CH₃O-, and R¹ may be the same residues or different residues, and

the diamine component including a paraphenylene diamine represented by General Formula (2)



where R² is a bivalent aromatic group selected from a group consisting of:

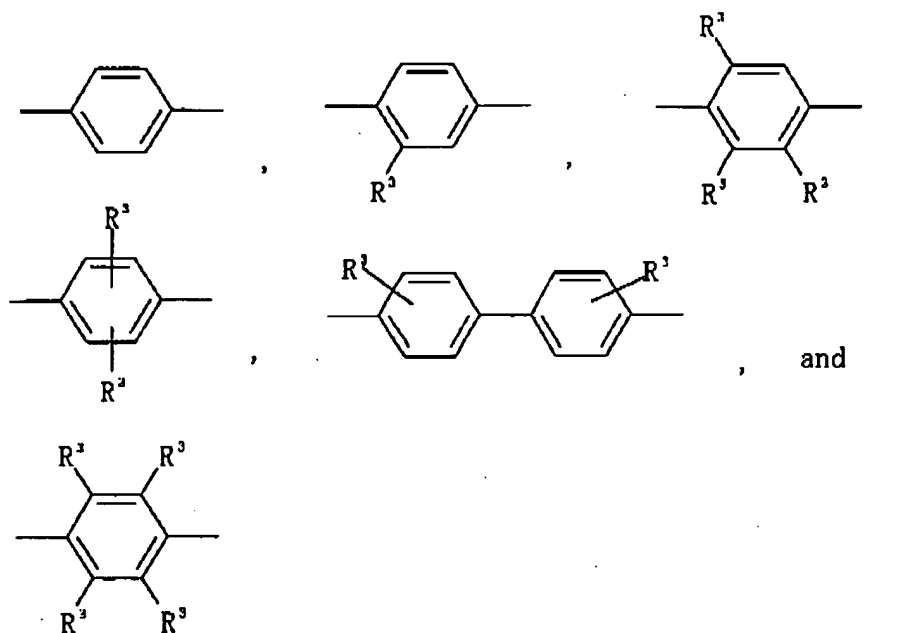
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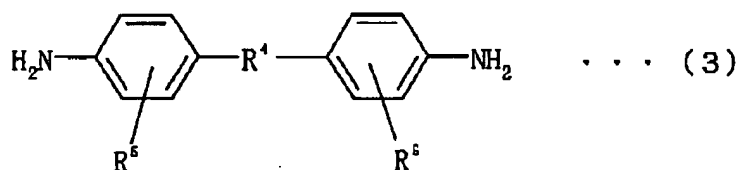
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and each R^3 in the group is independently any one of -H, -CH₃, -OH, -CF₃, -SO₄, -COOH, -CO-NH₂, -Cl, -Br, -F, and -OCH₃, and a diaminodiphenyl ether represented by General Formula (3),



where R^4 is a bivalent organic group selected from a group consisting of:

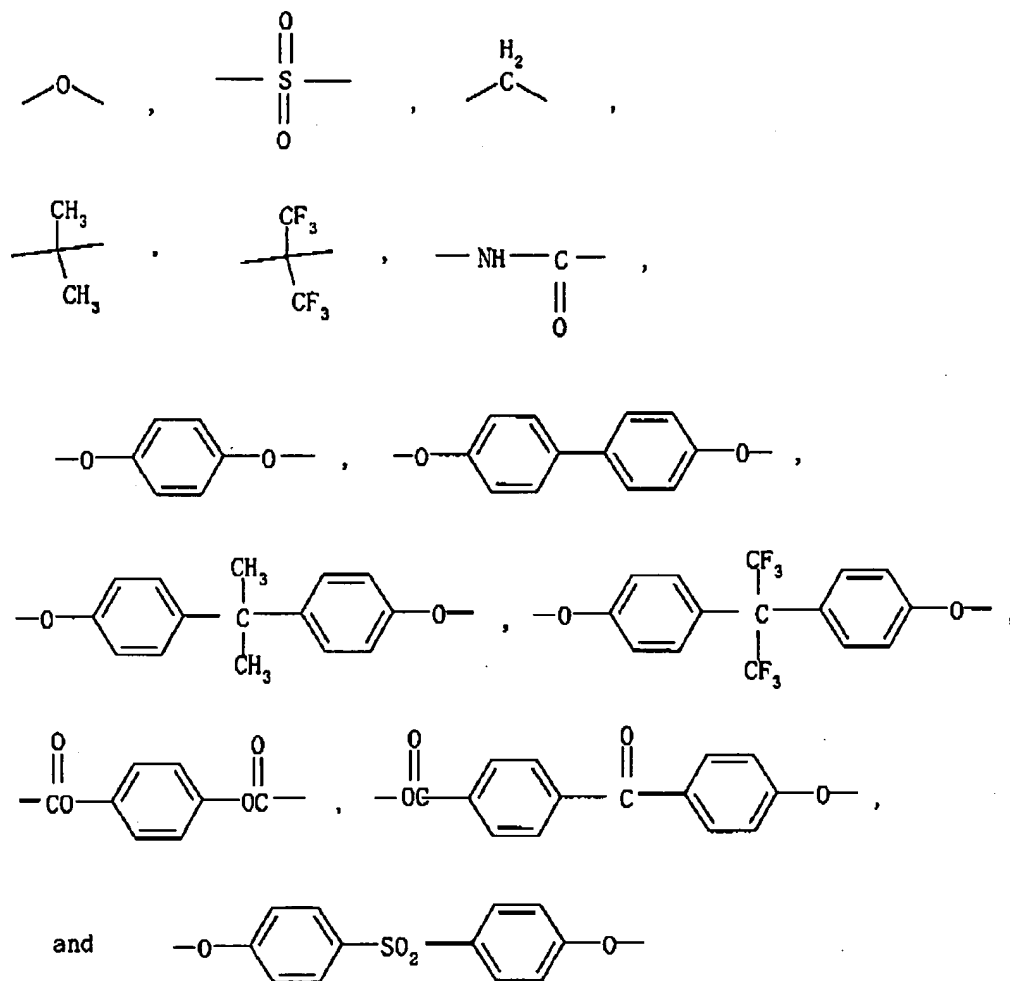
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and each R^5 in the group is independently any one of -H, -CH₃, -OH, -CF₃, -SO₄, -COOH, -CO-NH₂, -Cl, -Br, -F, and -OCH₃,

wherein:

the acid dianhydride component further including a bis(trimellitic monoester anhydride) represented by General Formula (4),

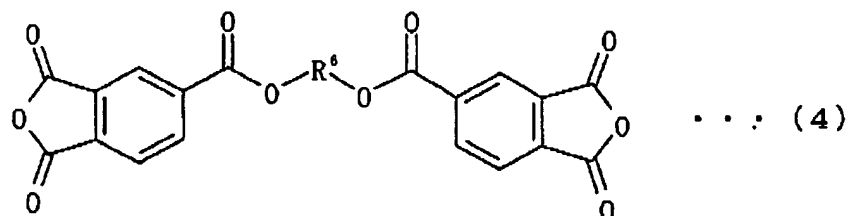
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where R⁶ is a bivalent organic group selected from a group consisting of:

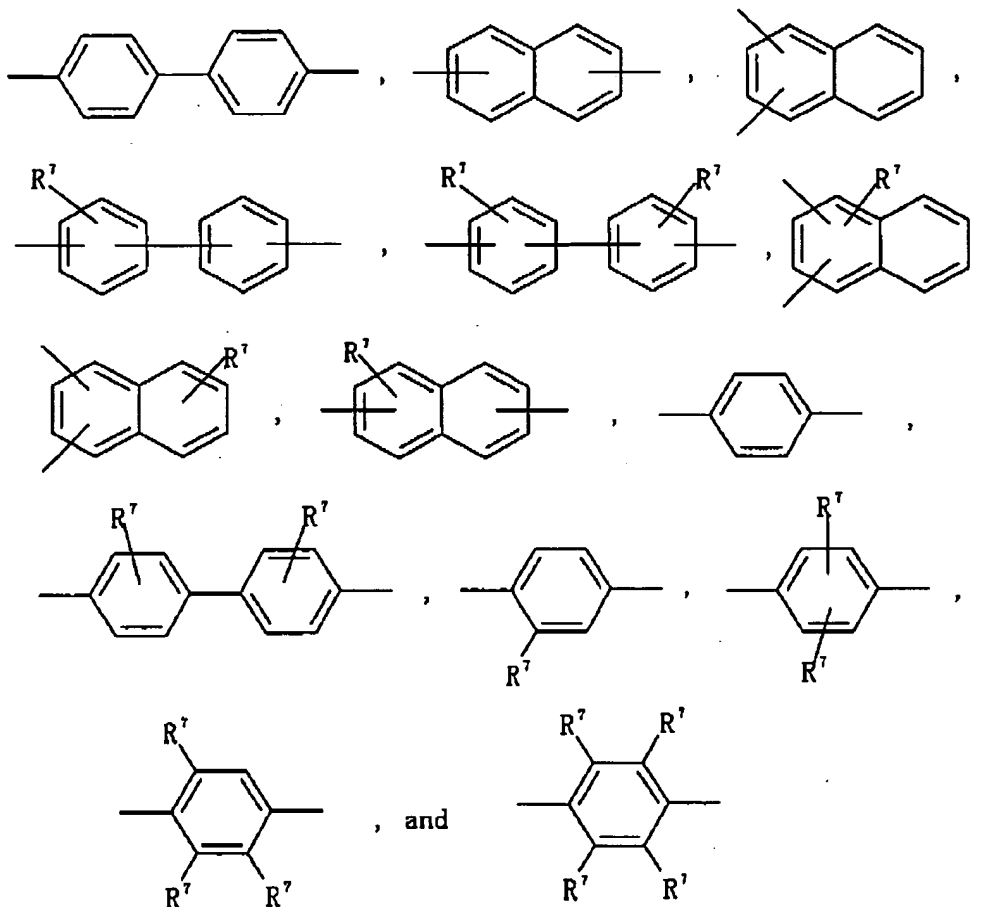
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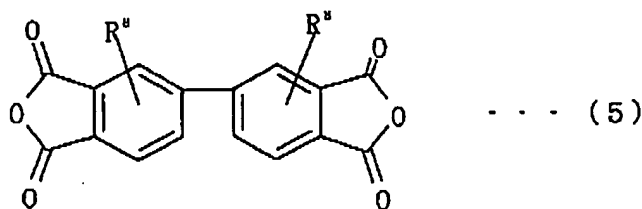
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and each R⁷ is independently any one of -H, -CH₃, -OH, -CF₃, -SO₄, -COOH, and -CO-NH₂, and

a biphenyl tetracarboxylic dianhydride represented by General Formula (5),



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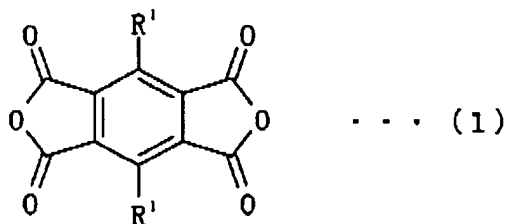
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where R^8 is a residue selected from a group consisting of H-, CH_3 -, Cl-, Br-, F- and CH_3O -, and R^8 may be the same residues or the different residues,

the polyimide film having a dynamic viscoelasticity whose $\tan \delta$ peak is located in a range of not less than 310°C but not more than 410°C , and whose $\tan \delta$ value at 300°C is not more than 0.05.

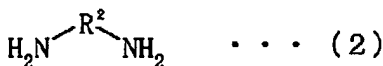
29-30. (Canceled)

31. (Previously presented) A polyimide film in which a pyromellitic dianhydride represented by General Formula (1),



where R^1 is a residue selected from a group consisting of H-, CH_3 -, CF_3 -, Cl-, Br-, F-, and CH_3O -, and R^1 may be the same residues or different residues,

a paraphenylene diamine represented by General Formula (2)



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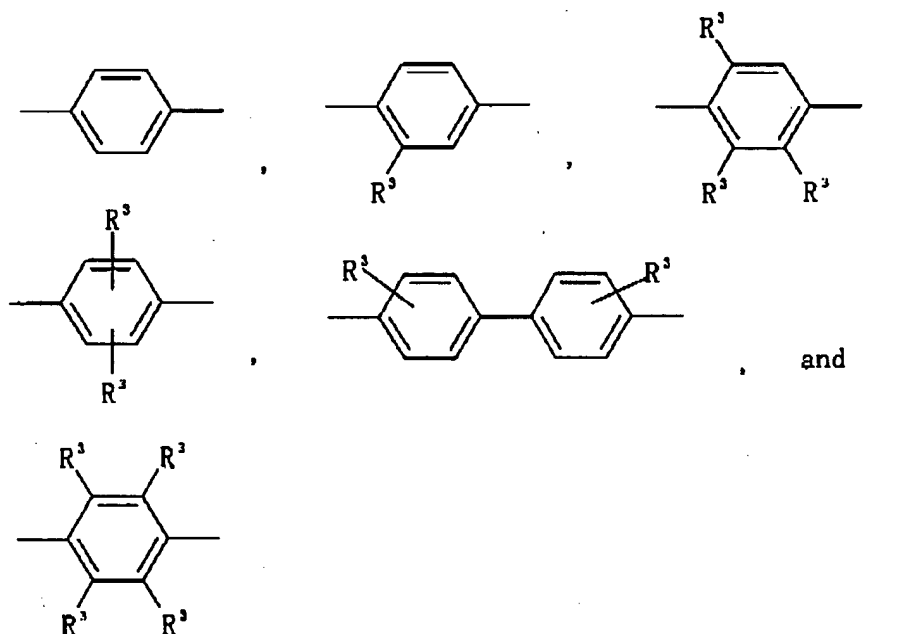
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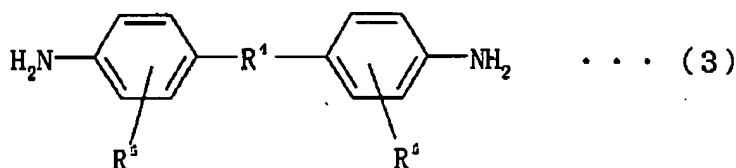
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where R^2 is a bivalent aromatic group selected from a group consisting of:



and each R^3 in the group is independently any one of -H, -CH₃, -OH, -CF₃, -SO₄, -COOH, -CO-NH₂, -Cl, -Br, -F, and -OCH₃, and a diaminodiphenyl ether represented by General Formula (3),



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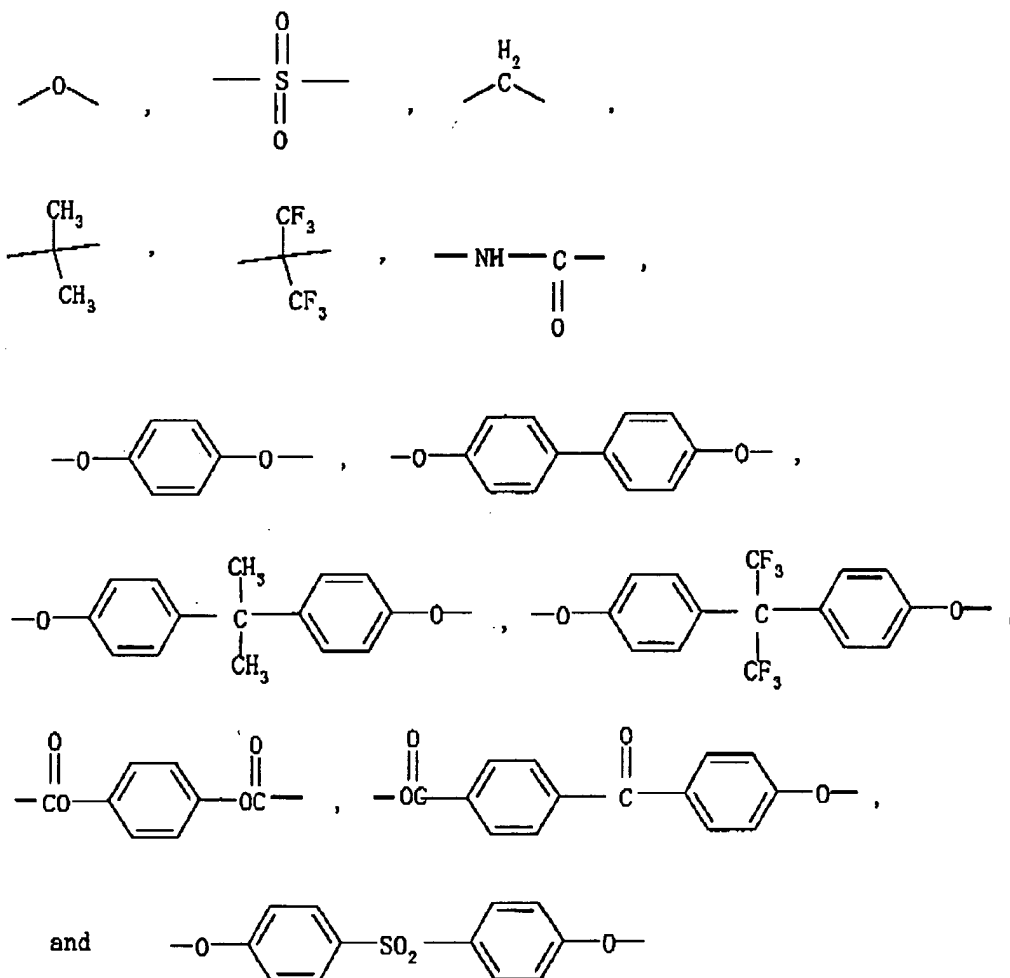
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where R^4 is a bivalent organic group selected from a group consisting of:



and each R^5 in the group is independently any one of -H, -CH₃, -OH, -CF₃, -SO₄, -COOH, -CO-NH₂, -Cl, -Br, -F, and -OCH₃,

are co-polymerized as necessary components,

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the polyimide film being manufactured by a method in which 5 mole% to 50 mole% of p-phenylene bis(trimellitic monoester anhydride) is used as an acid dianhydride component, and in which a peak of $\tan \delta$ in measuring dynamic viscoelasticity of the polyimide film is controlled in a range of 310°C to 410°C.